Multi-wavelengths in-situ scattering and absorption measurements of Saharan dust particles during FRAGMENT

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Multi-wavelength in-situ surface scattering and absorption properties of $PM_{2.5}$ and PM_{10} Saharan dust particles were measured during a dust emission field campaign performed in L'Bour (M'Hamid, Morocco) in September 2019 (Figure 1) within the FRAGMENT project (FRontiers in dust minerAloGical coMposition and its Effects upoN climaTe). The main goal of FRAGMENT is to understand and constrain the global mineralogical composition of dust along with its effects upon climate. Among other issues, the field campaigns are devoted to understanding the size distribution and mineralogy of emitted dust and its relationship with the parent soil properties. A wide variety of instruments for dust characterization were deployed including a radiometer, a fully equipped meteorological tower, cascade impactors, saltation sensors, OPC aerosol spectrometers, a polar nephelometer and an aethalometer, among others.

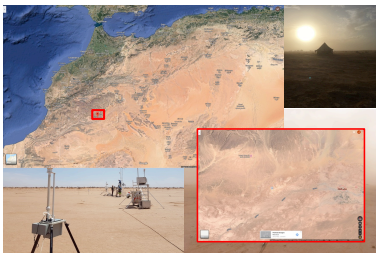

Figure 1: FRAGMENT measurement site in Morocco and experimental setting.

Here we report preliminary results from the optical measurements. Multi-wavelength (450, 525, 635 nm) scattering coefficient measurements at seven different angles (from 0° to 90°) were performed by means of a polar nephelometer (AURORA4000, Ecotech) and multi-wavelength (370, 470, 520, 590, 660, 880, 950 nm) absorption coefficient measurements were performed by means of an aethalometer model AE33 (Mcgee Scientific). An example (17-18/09/2019) of the performed scattering and absorption measurements is reported in Figure 2. From these extensive optical measurements, a set of climate relevant intensive optical parameters were determined, including scattering and absorption Ångström exponents (SAE and AAE), backscatter fraction (BF) and multi-wavelength single scattering albedo (SSA).

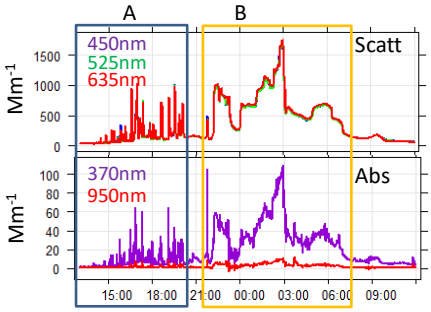

Figure 2. Example of scattering and absorption measurements (17-18/09/2020).

Figure 2 shows two markedly different periods both characterized by elevated scattering (up to 2000 Mm^{-1} in the example of Fig. 2) and absorption (up to 100 Mm^{-1} at 370 nm in Fig. 2). During episodes type A, both the extensive and intensive optical properties varied greatly from one measurement to another (1min resolution) reflecting the local production of particles of different sizes produced predominantly by the saltation process. During the A episode reported in Fig. 2, SAE, AAE, BF (525 nm) and SSA (370 nm) were in the range -1.25 – 0.5, 1.2 –2.2, 0.08 –0.16, 0.70 –0.98, respectively. Conversely, episodes type B were characterized by particles with intensive optical properties more constant with time suggesting the prevailing transport of dust with less variable size distributions compared to the type A episode. In a future step, the strong UV absorption properties of dust particles measured during the campaign will be linked to the size-dependent content of iron oxides in dust particles.

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